

NEZ PERCE BRIDGE
Yellowstone Roads and Bridges
Spanning Nez Perce Creek
on Grand Loop Road
Yellowstone National Park
Teton County
Wyoming

HAER No. WY-48

HAER
WYO
20-YELNAP
7-

BLACK & WHITE PHOTOGRAPHS
WRITTEN HISTORICAL & DESCRIPTIVE DATA

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HISTORIC AMERICAN ENGINEERING RECORD

NEZ PERCE BRIDGE

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Location: Spanning Nez Perce Creek on Grand Loop Road, 6.5 miles south of Madison Junction, Yellowstone National Park, Teton County, Wyoming
UTM: Madison Junction, WY, Quad. 12/514300/4935300

Date of Construction: 1935

Owner: Yellowstone National Park, National Park Service

Use: Vehicular bridge

Designer: Architectural plans by Thomas Carpenter, Branch of Plans and Design, National Park Service
General Plans and Specifications by G.M. Williams, Bureau of Public Roads

Builder: McLaughlin Construction Company, Livingston, Montana

Significance: Nez Perce Creek Bridge typifies the early design philosophy of the National Park Service, which was to use indigenous materials to harmonize man-made features with their natural surroundings. This philosophy is embodied in many of the park's Rustic Style buildings and structures.

Project Information: Documentation of Nez Perce Creek Bridge is part of the Yellowstone Roads and Bridges Recording Project, conducted during the summer of 1989 by the Historic American Engineering Record, a division of the National Park Service, under the co-sponsorship of Yellowstone National Park, the NPS Roads and Bridges Project, and the NPS Rocky Mountain Regional Office, Denver. Historical research and written narrative by Mary Shivers Culpin, Historian, NPS Rocky Mountain Regional Office. Engineering description by Steven M. Varner, Virginia Polytechnic Institute. Edited and transmitted by Lola Bennett, HAER Historian, 1993.

HISTORY OF GRAND LOOP ROAD

(See HAER WY-24, Yellowstone Roads and Bridges.)

HISTORY OF GRAND LOOP ROAD: MADISON JUNCTION TO OLD FAITHFUL

As early as 1873, a road had been completed from Virginia City, Montana to the Lower Geyser Basin, via Madison Canyon. Gilmer Sawtell, who catered to park visitors at his hotel on Henry's Lake in Idaho, built the west entrance road and named it Virginia City and National Park Free Road.¹ Four years later, the second superintendent of Yellowstone, Philetus Norris, proposed in his first report to the Secretary of the Interior, the construction of a wagon road connecting the wonders of the park which included a route connecting Lake Yellowstone through the geyser basins and exiting on the west side. As a result of the Nez Perce conflicts during the summer of 1877, the construction of a road from the headquarters at Mammoth Hot Springs southward to the Lower Geyser Basin became the highest priority construction project. Completion of this section of road would facilitate the movement of the military from Fort Ellis, Montana to Henry's Lake in Idaho or Virginia City, Montana, and of course, be used by the ever increasing number of visitors to the park.²

In 1880 improvements were made to Firehole River Road including opening a road into the midway geyser area.³ The following year, two footbridges were constructed over the Firehole in the Upper Geyser Basin. The next major work took place after the U.S. Army Corps of Engineers assumed responsibility for road construction in the park in 1883. At that time, the roads in the park were described as "barely passible and are daily growing worse. Just Sunday a lady was thrown out of the carriage and badly hurt at Fire Hole River. Between the 2 fords on Gibbon River, my wagon was turned over sideways and my wife thrown out. ... The roads are terribly worn down on one side which makes it difficult to keep in a wagon."⁴ Under the direction of Lt. Dan Kingman, a new bridge was built over the West Fork of the Firehole and some stretches of corduroy road were repaired and ruts filled. Finding the Mammoth Hot Springs to the geyser basins the most heavily traveled in the park, he also noted that it had the most serious natural obstacles and thus the "worst" in the park.

In the Firehole River to Upper Geyser Basin route, Kingman constructed a new road, as the old, poorly located road would be very costly to improve. The "unnecessarily long" and old road crossed a "kind of geyser swamp" in some places and crossed soils of a "black obsidian sand" in others.⁵ As the road neared the Upper Geyser Basin, the alignments of the old and new roads were almost the same. The new route, which cost a total of \$6,042.53, reduced the three to four hour travel time from the Marshall Hotel at the Forks of Firehole River the Upper Geyser Basin to one hour. Kingman described it as "well built" and said that the bridges and culverts had "substantial character." He further described it as "sensibly level, and as the roadbed is mostly composed of gravel that packs well, it is a very pleasant road to drive over."⁶

The first trestle bridge built in the park crossed Firehole River above Hell's Half Acre. Kingman felt that this bridge was well suited to the unusual conditions of the locality, "enormous quantity of hot water that this river received it never carried any ice, and as its discharge is remarkably uniform (there is hardly a difference of a foot between high and low water) it bears little or no drift wood." The trestle bridge, costing \$400, was covered with 4-inch hewed planks.⁷

In 1889 3.5 miles of new road had been built along the Firehole River above the Upper Geyser Basin and two bridges, in addition to the trestle bridge, had been built--a single-span structure and a two-span structure, both over Firehole River.⁸ In 1892 Lt. Hiram Chittenden urged the rebuilding of "the worst, most tedious, and least interesting drives in the park," the road

from Gibbon Falls to Lower Geyser Basin.⁹ In 1894 a new road was completed from a point on the old road near Gibbon Canyon south across the flats toward the Firehole and also connecting with the road west down along Madison River. At the same time, a bridge spanning Firehole River near Excelsior Geyser was built permitting teams to cross the river at this point and join the main road in the edge of the woods opposite.¹⁰ The next year the new road had been extended to Nez Perce Creek. In 1897 a new bridge was built over Firehole River near Riverside Geyser and a new footbridge built over Firehole River near Biscuit Basin.¹¹

During the first few years of the twentieth century, several bridges were built along this section. In 1903 a new steel truss bridge, whose material came from the American Bridge Company, was built over Firehole River, one-half mile above Excelsior Geyser.¹² More bridge construction and reconstruction occurred during 1905 and 1906. During the 1905 construction program, a steel truss bridge was built over Nez Perce Creek and two wooden bridges were reconstructed, one on the old road from Lower Geyser Basin to Excelsior Geyser, and the other just above Upper Geyser Basin. During 1906 the wooden bridges over Firehole River on the old freight road near the Fountain Hotel and over Firehole River above Upper Geyser Basin were reconstructed. "An attractive footbridge of rustic design was constructed over the small stream between the Castle Geyser and Old Faithful Inn".¹³

In 1907 the Army engineer supervised the repair of many of the park's wooden bridges and the replacement of some bridges with culverts. On this road section, a new wooden abutment was built at the bridge over Firehole River on the Fountain to Upper Geyser Basin road and tile culverts were laid at 7½ miles on the Norris to Fountain section.¹⁴ The following year, new decking was laid on two bridges spanning Firehole River, one crossing being near the Riverside Geyser and the other on the Upper Geyser Basin to West Thumb at the junction with Spring Creek. One 12-inch corrugated sheet iron culvert was placed at 9½ miles on the Norris to Fountain road.¹⁵

In 1909 a bridge inspection was done for all of the park bridges. The bridges on this section of road were described as follows:

Bridge No. 9, across the Firehole River at Riverside Geyser, Upper Geyser Basin. The present bridge consists of a two-truss wooden span on wooden piers and abutments. This bridge is entirely too light for the service required at this point. It is located at one of the most important points in the park, and in addition to the vehicle traffic, is at times loaded with sightseers viewing the Geysers. It is recommended that, owing the importance of the bridge, and its location, it should be made an attractive appearing structure, and further recommended that two 32' plate girder spans with curved effect underneath be used resting on concrete piers and abutments, and that the roadway be 20' in width so as to accommodate the sightseers without interference with the vehicle traffic.

Bridge No. 8, across the Firehole River at Hell's Half Acre, near Excelsior Geyser. This bridge was built in 1895, of white pine lumber, and consists of two spans with one pier in the center of the stream and two abutments. It is now in a decaying condition and its factor of safety is so much reduced that it should be removed at once. It is recommended that it can be replaced by two 50' low truss, pin connected steel spans and concrete pier and abutments.

As part of the inspection report on the bridges in the park, it was recommended that plans be drawn for a reinforced concrete bridge to be constructed over Firehole River near Riverside Geyser. Captain Wildurr Willing of the Corps of Engineers felt that since this was one of the most visited areas in the park, it was necessary that the bridge be of an aesthetic design.¹⁶ However, because of costs, a 65-foot steel arch bridge was built by the Minneapolis Steel and Machinery Company in 1911. As late as 1923, the 1911 bridge was still in use.¹⁷

Not many major changes or improvements were made to this road section after the Army left the park and the newly created National Park Service assumed the road construction program. The new director's did suggest the completion of the Firehole Cutoff road.¹⁸ The 4-mile freight road, which paralleled the main road between Fountain Soldier Station and Excelsior Geyser, was closed in 1917 due to the unsafe condition of the wooden truss bridge over Firehole River about one mile from soldier station. A new 50-foot bridge was built as a replacement and a 40-foot bridge over Nez Perce Creek was reconstructed.¹⁹ And in 1921, a new foot bridge was constructed over Firehole River near Castle Geyser.²⁰

Prior to the next major construction program initiated after the Bureau of Public Roads took over the road work in Yellowstone in 1926, Firehole River Road south of Firehole Cascades for 3.5 miles was widened for two-way traffic.²¹ Work began in May 1925 in the immediate vicinity of Firehole Cascades, and a camp was set up near the cascades. By the middle of July, 5,160 cubic yards of excavation had been removed by hand and teams labor. Of the total, 4,400 cubic yards was of solid rock. The crews installed approximately 150 feet of drainage culvert. The cost of the 1.5-mile project was approximately \$6000. In 1926 Director Mather reported that the work along Firehole River between Madison Junction and Firehole Cascades was "constructed on the highest standards of any used in the National Park Service [as] the beauty of the canyon justifies the very great attention that is being given to details of wall and fill construction."²² The 1926 project, which involved widening a 1.5-mile section of the road in very narrow places and new construction for 1.5 miles, had originally been started by the Army Corps of Engineers, but was abandoned in 1916. With the assistance of one foreman, one cook, one flunkey, one compressor operator, one jackhammer man, one powder man, one grademan, one four-horse teamster, two two-horse teamsters, one axeman, one blacksmith, six laborers, and three teams. The project required the excavation of 360 cubic yards of common material, 820 cubic yards of loose rock, 2,945 cubic yards of solid rock and the installation of 120 linear feet of 12-inch CMP culvert, and 24 linear feet of 18-inch CMP culvert. All excavated material was used on the project. "Neither the amount of material nor the nature of the country would permit fills on a naturally stable slope and all embankment was constructed with hand placed fill or rubble wall on slopes of $\frac{1}{2}$:1 or $\frac{1}{3}$:1."²³

Work also began on a new bypass road at Fountain Paintpot as the old road was widened and improved to become a short loop road. The necessary fill material was hauled from the cut at milepost 7, about $1\frac{1}{2}$ miles distant. About half of the construction in this section was through sandy material which required a binder to create a stable surface. A sharp curve above Firehole River Bridge at Excelsior Geyser was widened by the excavation of 600 cubic yards of solid rock. The borrow for the material on this project came from a pit near Firehole Lake. The project was finished in July, 1930. A total of 2.16 miles of road had been built and 196 linear feet of 18-inch CMP culvert had been installed.²⁴

Shortly thereafter, the crews began lessening the curvature and widening the grade on a sharp curve at a point five miles north of Old Faithful. This project required the hand excavation of about 475 cubic yards of material which was then used to widen the grade from 18 to 24 feet, both at the curve and a distance of 200 feet on either end. All of the excavation was through a sand-clay formation, thus no additional surfacing was required. It was finished with an application of oil.²⁵

In 1930 the realignment of the Norris Junction to Madison Junction road resulted in two steel bridges across Gibbon River approximately 9½ miles below Norris Junction being abandoned. It was proposed that both would be removed, however one bridge, which served the old stage road (Mesa Road) to Firehole Cascades, was still needed as diverted traffic used this route while the new road was being completed. The other Gibbon River Bridge, a steel arch bridge with concrete floor, constructed in 1913 at a cost of \$4,010, was dismantled and reassembled over Firehole River on Fountain Freight Road. This relocated bridge replaced an unsafe timber bridge. This bridge has since been removed.²⁶

At an inter-bureau conference held in San Francisco in 1931, the National Park Service requested a reconnaissance survey be completed for the road between Firehole Cascades and Old Faithful. The average daily traffic during that period was about 600 vehicles per day with about 10 percent of the total being trucks and buses. The survey found that the first 2.5 miles from Madison Junction to Firehole Cascades, which had been reconstructed by day labor of the National Park Service and surfaced by the Bureau of Public Roads in 1931, to be in satisfactory condition. Thus most of the survey was for the remainder of the road. The Park requested the feasibility of rerouting the main road via Firehole Lake, the east end of Biscuit Basin and Black Sand Basin. They also felt that if this was not desirable then they wanted loops built in these areas. The fairly recently built bypass of Fountain Paintpot proved to have reduced the interest at this point, thus the park desired a rerouting produce a closer approach. Within 10 days, the survey crew recommended many slight variations from present alignment, flattening of curves, reducing curvatures and widening the present road. It was estimated that approximately 10 culverts would be needed for every mile. The width of the road from shoulder to shoulder should be 28' for the main roads and 22' shoulder-to-shoulder for the proposed loop roads. The four bridges on the project were considered too narrow and too light of construction to carry the average daily traffic load, and therefore should be replaced.²⁷

The location survey for this project was completed in 1932 and the project Morrison-Knudsen Company of Boise, Idaho, was awarded the grading contract on July 17, 1934, for the low bid of \$188,216.10. The contractor began establishing his camp at Goose Lake on July 19, 1932. The camp had frame buildings which facilitated 125 men. Family members were provided for at a camp just across the creek from the main camp. The engineers camp consisted of two 16x16 portable houses and two tents and was located at Riverside Geyser. Work began immediately and closed for the season on December 26, with 84 percent of the project completed. The 1935 season began in May, and was 95 percent finished by September 9 when the contractor closed down for the year.

By the end of the 1935 construction season, the road had been graded to a minimum width of 28' at the recommendation of the National Park Service. The Bureau of Public Roads standard for that time was a 26' roadway, shoulder-to-shoulder. The bridge construction was handled by separate contracts. All cross and side drainage structures were corrugated metal (1,898 linear feet) and vitrified clay pipe (4,254 linear feet). Since many of the drainages are through areas of unusual chemical composition, vitrified clay pipe was preferred. The 271 cubic yards of rock for the masonry work was obtained at a quarry at a point where the Mesa Road leaves the Grand Loop Road between Gibbon Falls and Madison Junction. Because of the superior condition of the subgrade, it was deemed possible for traffic to move over the road for a season or two until the final surfacing is done.²⁸

Concurrently with the road construction project, a bridge contract was awarded to McLaughlin Construction Company of Livingston, Montana for construction of Nez Perce Creek Bridge, Firehole River Bridge and a foot bridge over Firehole River at Excelsior Geyser. Work began in 1934 and the bridges were completed on September 6, 1935. Following the completion of the bridges, the park felt "great improvements" had been made in the roadways. The use of 4:1 on

low embankments was preferable, however that combined with not diverting branch streams left some undesirably conspicuous culvert headwalls especially on the road recently completed between Madison Junction and Old Faithful.

It is believed that a change in design of culvert headwall is desirable and that an improvement in appearance can be readily obtained. One plan would be to move the headwalls closer to the road shoulder, to bevel the projecting corner, and to provide 90 degree wingwalls on the same slope as the embankment. Another method would be to bevel the end of the culvert and protect the bank by hand placed embankment or by masonry laid flush with the surface of the embankment. While the masonry of large bridges adds to the attractiveness of the roadway it seems to be undesirable to make the headwalls of small culverts conspicuous and the more invisible they can be the better the appearance of the roadside.²⁹

Another landscape issue identified with this section's bridge work was the type of curbing desired. The Park felt that a concrete curb is more serviceable than a masonry curb. It is, however, suggested that the appearance of wingwalls would be improved by making the wingwalls all of masonry including a masonry curb rather than introducing a concrete curb as a portion of a masonry wall. A single course of masonry above a concrete curb does not give the appearance of being adequately bound into wall.³⁰

Both the newly constructed Nez Perce Creek Bridge and the Firehole River Bridge have the combination of the concrete curb with the masonry walls.

The next major project on this road section was the relocation of approximately 2½ miles of road between a point on Grand Loop Road immediately north of Madison Junction to a point on Grand Loop Road near Firehole Cascades. The old road, which is along Firehole River through a narrow canyon, was first constructed by the Army engineers, but abandoned in 1910 because of construction costs and the very heavy character of the work. In 1925, National Park Service day labor forces resumed construction on the section and it was eventually surfaced by the Bureau of Public Roads in 1931. The 1938 Preliminary Location Survey proposed the construction of a new bypass road to alleviate the serious bottleneck imposed by the narrow road through Firehole Canyon. The engineers specified that the new bypass be built on the same standards as the rest of Grand Loop Road. Upon completion, the old road could be used as a scenic drive.³¹ This report resulted in preliminary plans, however the construction did not occur for several years. In 1949 a 38-mile chip sealing project on the Mammoth Hot Springs to Firehole Canyon road and a grading and base surfacing project in Firehole Canyon began.³²

Many improvements, such as widening the roadways and bituminous surfacing, were made on the Madison Junction to Old Faithful section during the 1960s. A number of remnants of old roads were obliterated and the scenic loop roads were resurfaced and improvements made to the shoulders. Rock work was repaired after the 1959 earthquake.³³

In the 1986 Parkwide Engineering Study, this section of Grand Loop Road was divided into four segments for evaluation. The first segment of 2.58 miles begins at milepost 34.12 and ends at 36.70. The roadway width from shoulder to shoulder is 32' and the pavement or surfacing

width is also 32'. The surface type is bituminous plant mix and the surface is in fair condition. The shoulder width is 4' and the shoulders are in fair condition. The posted speed limit is 45 mph. The horizontal and vertical alignment is good. The roadside condition is fair, with vegetation encroaching on roadway restricting the sight distances in some areas due to narrow clearing limits. One modern bridge, Gibbon River Bridge No. 5, is on this segment. The average daily traffic in 1985 was 5,600 vehicles with a proposed average daily traffic for 2005 of 6,800. This segment is designated as a part of the Trans-America Bicycle Route.

Segment 2 covers 5.56 miles between milepost 36.70 and 42.26. The roadway width from shoulder to shoulder ranges from 27' to 28' and is covered with a bituminous plant mix. The surface condition is poor. The base and subbase condition is fair to poor. The shoulder width is from 2' to 3' and the condition is fair. The posted speed limit is 45 mph. The horizontal and vertical alignment is good. The roadside condition is generally good with some minor restriction of sight distance caused by encroaching vegetation. This segment is designated as part of the Trans-America Bicycle Route and it also transverses prime and unique geological, visual, and thermal natural resources. One historic bridge, the Nez Perce Creek Bridge, is on this segment. There are no other major bridges or structures.

Segment 3 covers two sub-segments. The first sub-segment is .29 mile between milepost 42.26 to 47.93. The roadway width from shoulder to shoulder is 36' and is covered with a bituminous plant mix. The surface condition is good. The base and subbase condition is good. The shoulder width is 2' and the shoulder condition is good. The posted speed limit ranges from 25 to 45 mph. The horizontal and vertical alignment is good. The second sub-segment covers 5.38 miles from milepost 42.55 to 47.93. The roadway width from shoulder to shoulder is 26' with a surface width of 24'. The shoulder width is 1 foot and the shoulder condition is poor. The posted speed limit is 45 mph. The horizontal and vertical alignment is good. The roadside condition is fair with encroaching vegetation in some areas. Both of the subsegments are part of the designated Trans-America Bicycle Route and the road runs through prime and unique geological, visual, and thermal natural resources.

Segment 4 covers 1.76 miles from milepost 47.93 to 49.69. The roadway width from shoulder to shoulder is 32' with a surfacing width of 31'. The surface is covered with a bituminous plant mix and the condition is considered very poor with severe alligator cracking, rutting and pot holes. The base and subbase are in fair condition. The posted speed limit is 45 mph. The horizontal and vertical alignment is good. The roadside condition is good. This corridor is part of the Trans-America Bicycle Route. One historic bridge is on this segment, the Firehole River Bridge. No other major bridges or structures are on this segment.³⁴

DESIGN AND CONSTRUCTION OF NEZ PERCE BRIDGE

Nez Perce Bridge carries Grand Loop Road over Nez Perce Creek 6.5 miles south of Madison Junction. The bridge was built during the reconstruction of the Madison Junction to Old Faithful road section. The bridge is a three-span concrete deck girder type structure with continuous slab and masonry piers and abutments. The bridge has two spans of 25'-3" and one span of 28'-0". Span length is measured from center of support to center of support. The structure length of the bridge center line not including the wing walls is 78'-6". The deck width is 27' while the bridge roadway width, curb-to-curb, is 24'.³⁵

The bridge is skewed at 45 degrees to the abutments. The design load is 15 tons. All concrete in the bridge is class "D". "D" refers to the amount of cement in the mix. "A" has the highest proportion of cement in the mix and is the strongest concrete. The maximum size of the coarse aggregate is 1½". The curb and three spans were poured in one operation. The slab is 1'-3" thick and has longitudinal and transverse reinforcing. The curb rises 9" above the slab and is 1'-6"

thick. The longitudinal reinforcing bars are near the top and bottom of the slab and are 7 inches on center. The diameters of these bars vary between $\frac{1}{2}$ " and $1\frac{1}{4}$ ". The transverse reinforcing bars are near the top and bottom of the slab and are 14" on center in the middle span. The diameters of these bars vary between 1" and $1\frac{1}{4}$ ". The longitudinal bars are lapped 4' at all splice points which occur 6' before and after the center lines of the piers.³⁶

The guard rail consists of 2"x5" steel bars sunk into a 4"x7"x13" socket in the curb. Four-inch channels at 6.25 pounds per foot cupping downward frame into the bars near the top and bottom to form horizontal rails. One-inch diameter bars frame vertically between the rails $8\frac{1}{4}$ " on center. The rail rises 2'-9" above the curb.³⁷

The abutments and piers spring from spread footings on firm material. The abutments batter 1:12 on the inside and 2:12 on the outside. The abutment has a 1-foot deep concrete seat for the deck slab. The abutments are 3' wide at the top. The wing walls batter 2:12 on the inside and 1:12 on the outside. They are 1'-10" wide at the top. The wing walls extend 16 feet from the abutment. The piers rise approximately 7' from the normal water elevation. They batter 1:12 on all sides. The piers have a 2'x1' concrete seat for the deck.³⁸

The estimated quantities of materials used in the bridge construction were:

Class "D" concrete.....	110 cu. yds.
Reinforcing steel.....	32,000 lbs.
Masonry.....	264 cu. yds.
Steel rail.....	157 linear ft.
Excavation.....	135 cu. yds. ³⁹

Construction of this bridge was part of a contract awarded to McLaughlin Construction Company of Livingston, Montana, for the construction of three bridges--Nez Perce Creek Bridge, Firehole River Bridge at Morning Glory and a footbridge across Firehole River at Excelsior Geyser.

Excavation work for abutment no. 2 began on September 14, 1934 with a crew of 8 men. The crew grew to twenty-five men as excavation work began on the other abutment and the piers. The excavating crews and the masonry crews alternated between the other bridge projects. The crushed aggregate and the stone for the masonry work came from a quarry on the Mary Lake Trail about $1\frac{3}{4}$ miles to the right of Station 513. A roadside pit at Station 370 provided the sand for both the masonry and concrete work. The crews worked until November 9, 1934 completing about 25 percent of the project.⁴⁰

The crew resumed work in June 1935. Prior to the 1934 season's closing, a section of the cliff at the stone quarry had been shot down to provide sufficient stone for immediate resumption of masonry work at the beginning of the 1935 season. However, the shape and size of the stones, made it skeptical if the quarry could provide enough large stones for all three bridges in the project. The decision was made to use the stones for Nez Perce Creek Bridge, which blended well with the environment, and open another quarry at a point about 1 mile south of Gibbon Falls where the old Mesa Road leaves Grand Loop Road.

The traffic was not inconvenienced by the bridge construction as the old bridge remained in use throughout the construction period. Upon completion of the new bridge, the old bridge was removed and salvaged. McLaughlin Construction Company of Livingston, Montana constructed the bridge at a total cost of \$16,238.20.⁴¹

ENDNOTES

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